معن سلام قعدان

[redacted]

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اعداد شادي دراغمة 10 - 11

60/70

Palestine Technical University

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Mid Term Test 1. 2011 - 2010 الفصل الثاني **Dynamics**

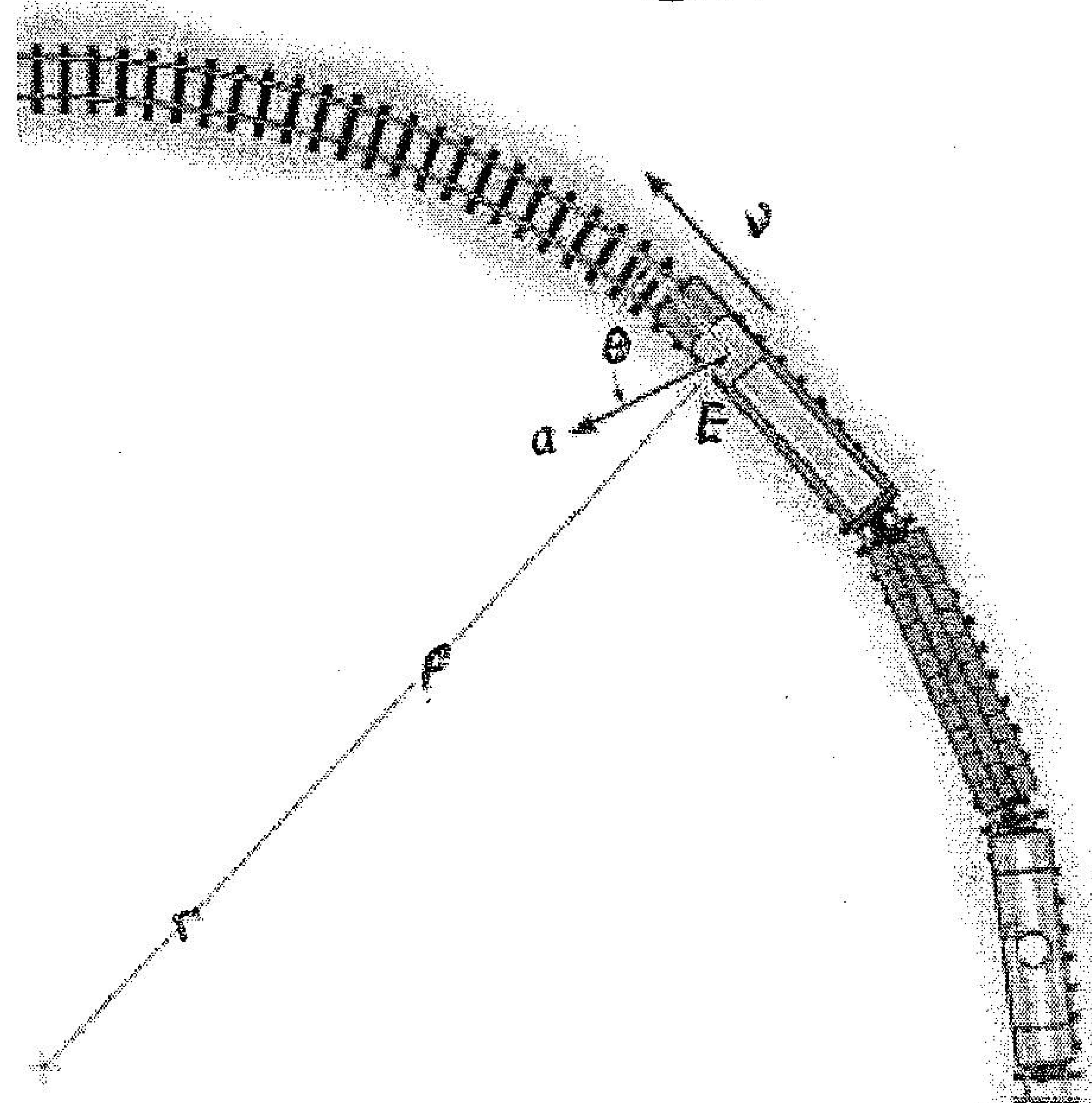
13th March 2011

Good.

Section A – Answer both questions from this section

QA1

At a given instant the train engine at E has speed (v = 35 m/s) and acceleration a = 18 m/s², acting in the direction shown with θ = 70 °.



Determine

The train's acceleration in the tangential and normal directions(a_t and a_n)and the radius of curvature (ρ) of the path at his instance.

Choose one of the following answers:

a) a_t = 8.26 m/s², a_n = 18.75 m/s², ρ = 70.52 m

b) a_t = 4.26 m/s², a_n = 13.95 m/s², ρ = 74.37 m

c) a_t = 6.16 m/s², a_n = 16.91 m/s², ρ = 72.42 m

d) a_t = 5.56 m/s², a_n = 11.9 m/s², ρ = 62.48 m

e) None of the above [5 marks]

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Ans. [10 marks]

$a_t = 18\cos 70° = 6.16 \text{ m/s}^2$

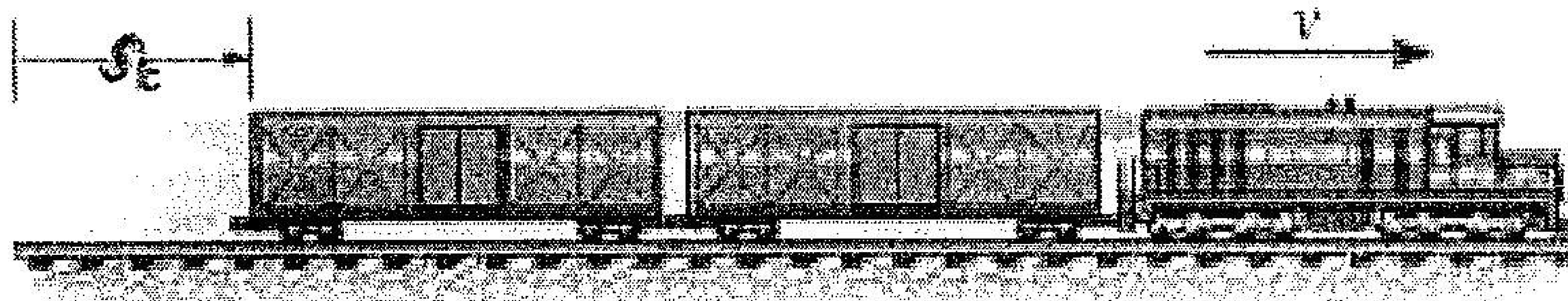
$a_n = \frac{v^2}{\rho} \Rightarrow a_n = 18 \sin 70 = 16.91 \text{ m/s}^2$

$\therefore a_n = 16.91 = \frac{(35)^2}{\rho} \Rightarrow \therefore \rho = \frac{(35)^2}{16.91} = 72.4 \text{ m}$

10/10

QA2

A freight train travels at $v = v_0(1 - e^{-bt})$, where (t) is the elapsed time. Determine the distance travelled in 3 seconds, and the acceleration at this time, given that v_0=20 m/s and b=1/s



Choose one of the following answers:

a) d =53 m, a = 1.6 m/s^2

b) d =41 m, a = 1.0 m/s^2

c) d =63 m, a = 1.9 m/s^2

d) d =35 m, a = 2.3 m/s^2

e) None of the above [5 marks]

Ans. [10 Marks]

$V = V_0(1 - e^{-bt})$

$\therefore V = 20(1 - e^{-t}) = 20 - 20e^{-t}$

$a = \frac{dV}{dt} = 0 + 20e^{-t} = 20e^{-t}$

$\therefore a(t=3) = 20e^{-3} = \frac{20}{e^3} = 0.995 \approx 1.0\ m/s^2$

$X = \int V(t)\,dt = \int_0^3 20 - 20e^{-t}\,dt$

$= 20t + 20e^{-t} + c$?

5/5 ; 4/10 ; How? ; Page 2

~~$x(t=3) = 20(3) + 20e^{-3} + c$~~

~~$X = X_0 + V_0 t + \frac{1}{2}at^2$~~

$\therefore x(t=3) = 20(3) + 20(e^{-3}) + c$

$= 60 + 1 + c$

$\Rightarrow$ but $c = -20$ $\Rightarrow$ $x = 61 - 20 = 41\ m$

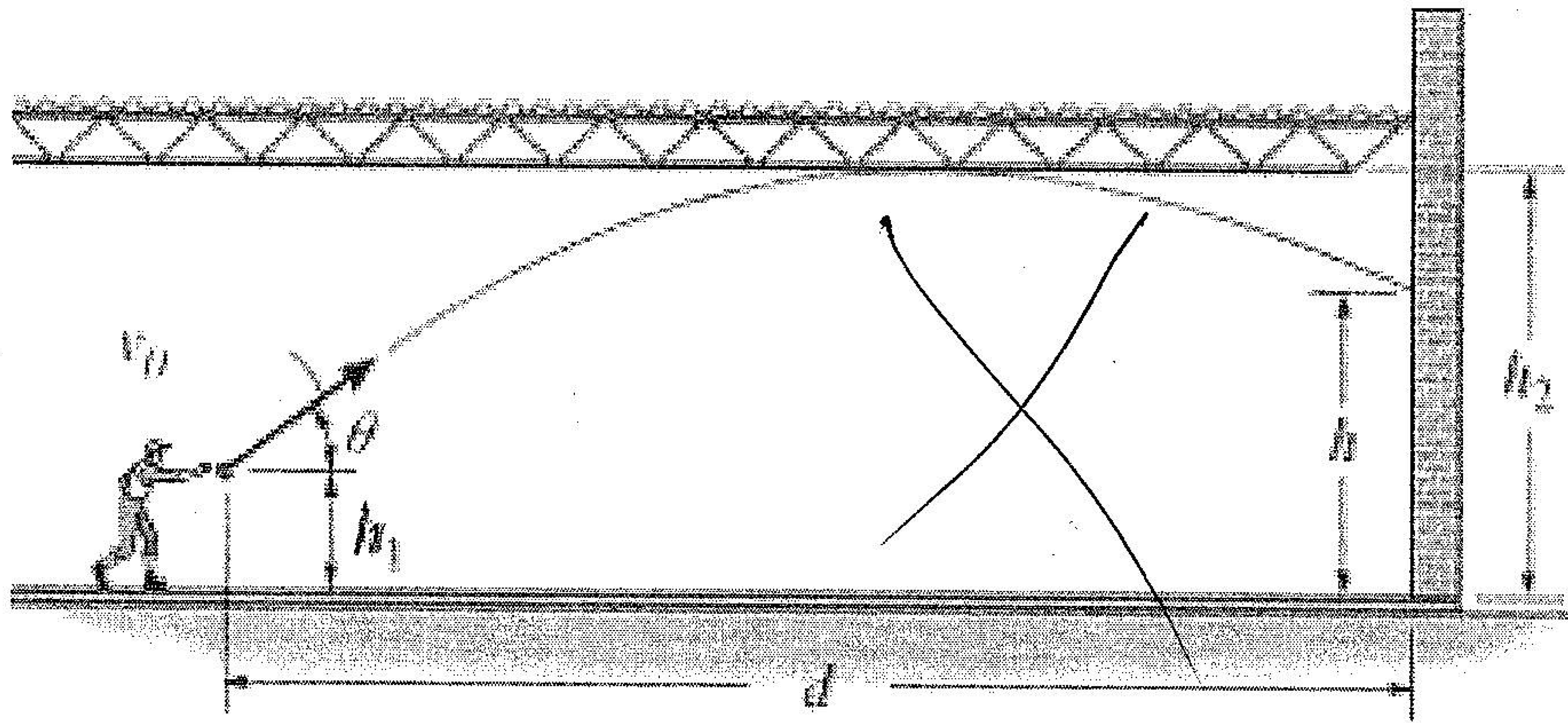
Section B – Answer 2 questions only from this section

QB1

A player whose height h_1 = 1.75 m, stands a distance d=20 m from the wall and throws a ball at it with a speed v_0 = 15 m/s. If the room has a ceiling height h_2 = 5 m, determine the following:

(i) The angle θ at which the player should release the ball so that it strikes the wall at the highest point possible. [10 marks]

(ii) The highest point possible (h)? [10 marks]



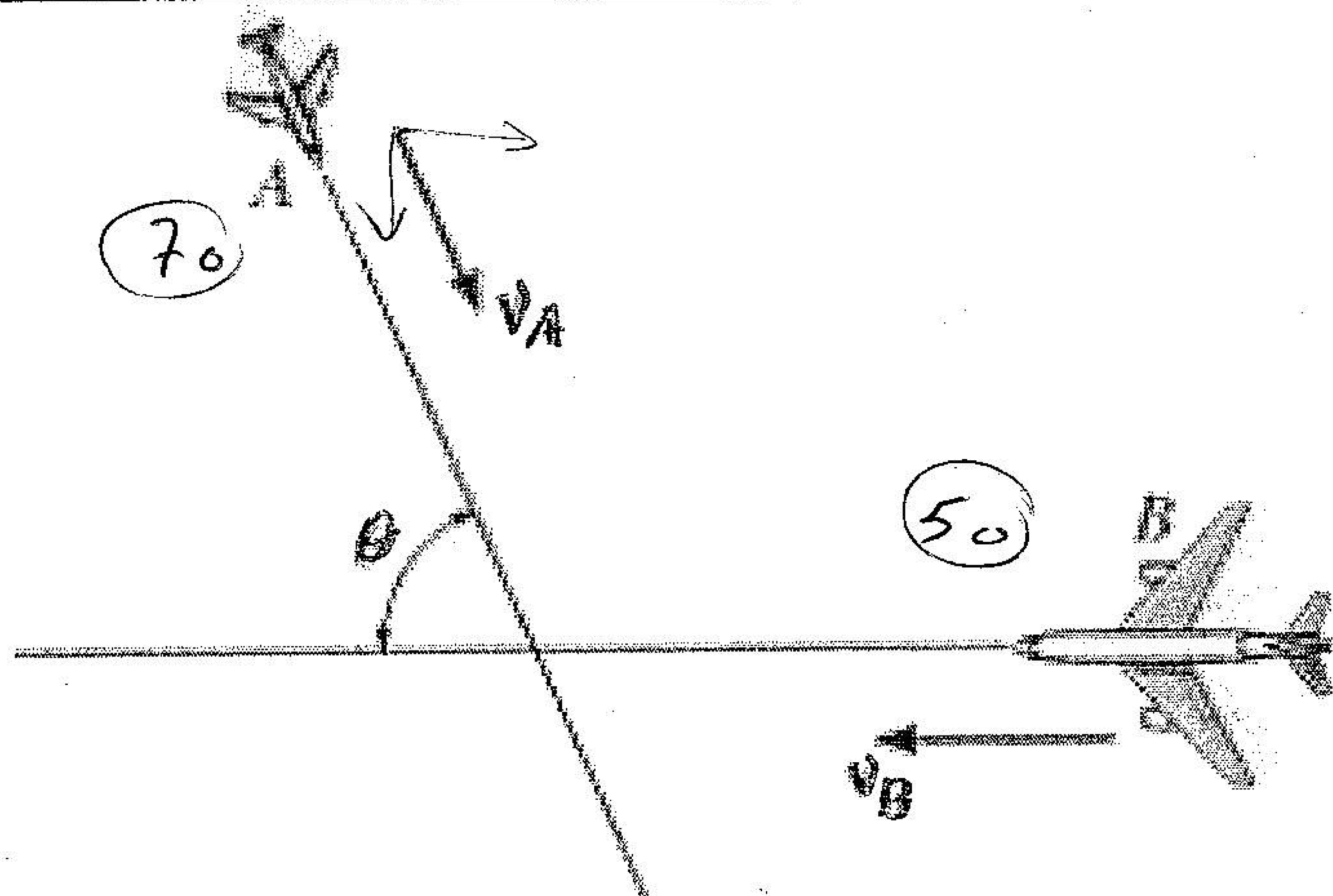
Ans.

القسم الثاني (B) يكون عبارة عن (3) اسئلة، تستطيع حل أية اثنين وترك الثالث.

انا قمت بترك هذا السؤال، وقمت بحل السؤالين التاليين

QB2

Two planes, A and B, are flying at the same altitude such that the angle between their straight-line courses is θ = 60°. Their initial positions from the intersection point 'O' are given by: OA = 70 km and OB = 50 km. If their velocities are uniform and are given by: v_A = 700 km/h and v_B = 500 km/h , determine



a) The velocity of plane A with respect to plane B (as a vector and also its value) [10 marks]

b) The displacement of B with respect to A after 10 seconds, assuming both planes stay on their respective courses) [10 marks]

Ans.

$V_A = 700 \cos 60\, i - 700 \sin 60\, j$

$= 350 i - 606.2 j$ km/h

$V_B = -V_B i = -500 i$ km/h

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(a) ∴ $V_{A/B} = V_A - V_B = (350 i - 606.2 j) - (-500 i)$

$= 350 \hat{i} - 606.2 j + 500 \hat{i}$

$= 850 \hat{i} - 606.2 j$

$|V_{A/B}| = \sqrt{(850)^2 + (606.2)^2} = 1044.02$ km/h

(b) $X_{B/A} = X_B - X_A$

$X_B = X_0 + V_B t + \frac{1}{2} a t^2 = 50 + (500 \times 10) + 0 = 5050$ km

this is seconds which needs to be converted

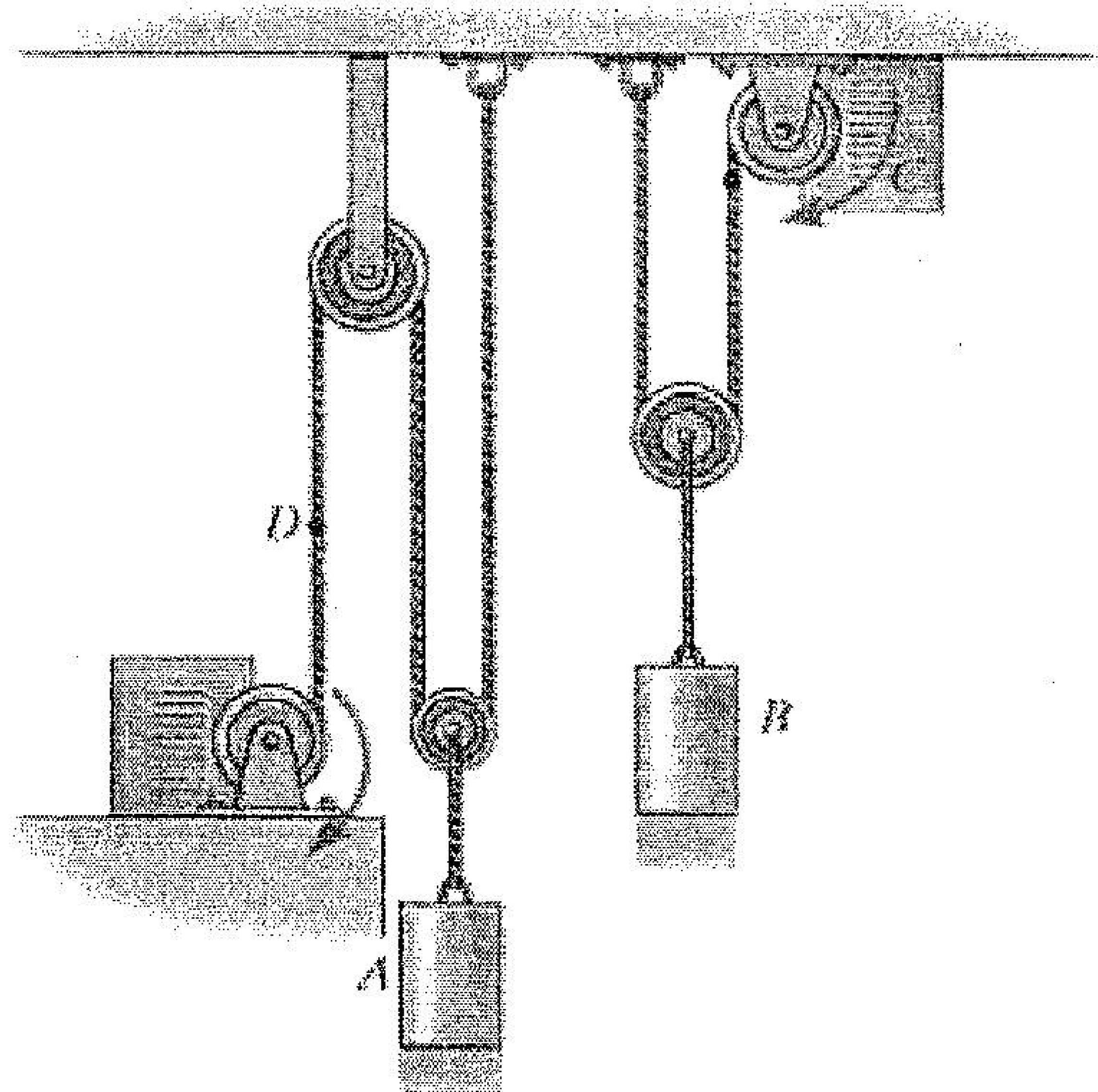
$X_A = X_0 + V_A t + \frac{1}{2} a t^2 = 70 + (700 \times 10) + 0 = 7070$ km

∴ $X_{B/A} = X_B - X_A = 5050 - 7070 = -2020$ km

3/10 +1 for efforts

QB3

The pulley system below consists of 3 frictionless pulleys of negligible weights. The system is driven by two electrical motors at C and D. The motor at C draws in the cable with a constant velocity v_C= -4 m/s while the motor at D draws in the cable D with a constant acceleration of a_D=8 m/s² If v_D = 0 when t = 0, determine:

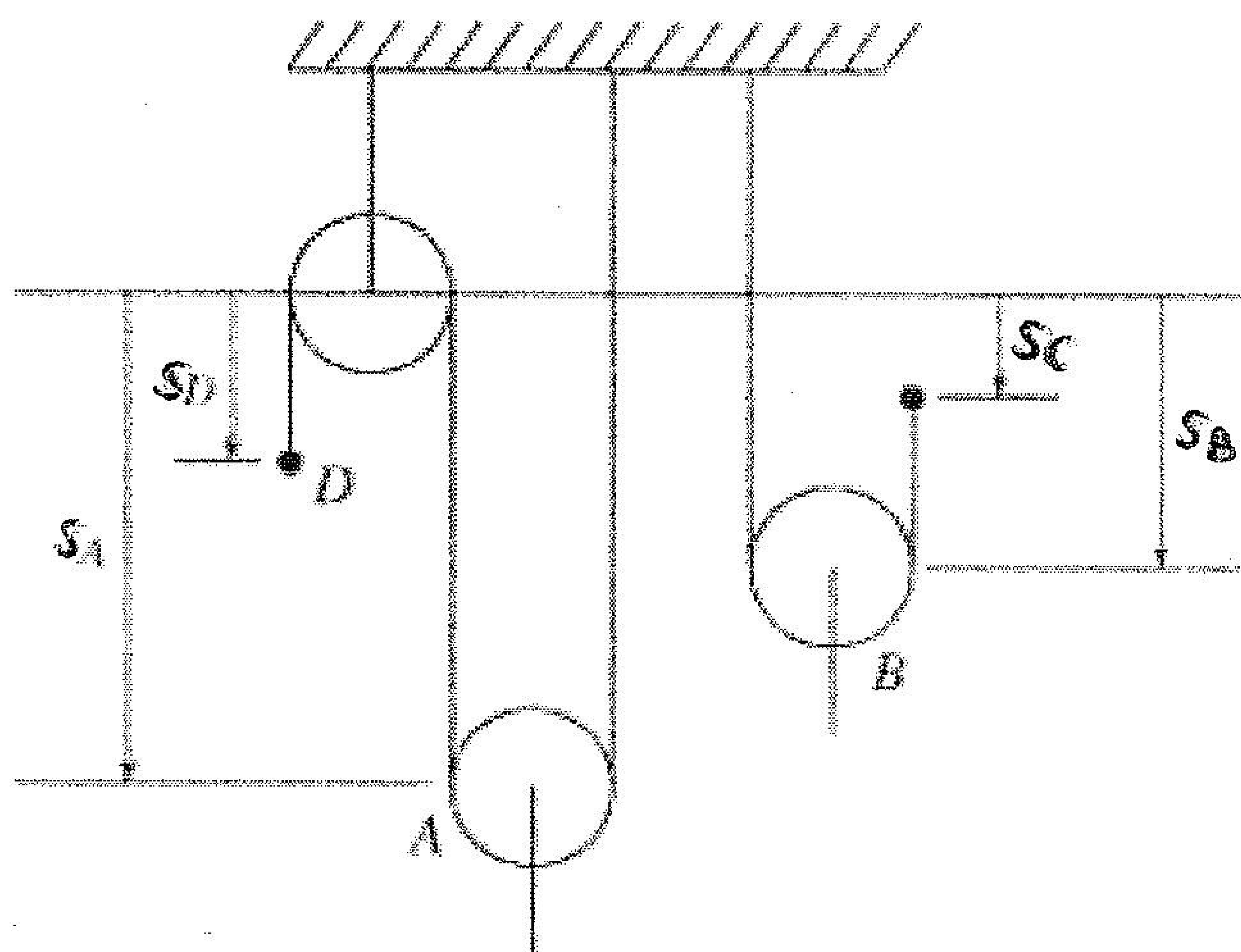


a) The time needed for block A to rise a distance of 5 m, and [10 marks]

b) The relative velocity of block A with respect to block B when this occurs.

[10 marks]

[Hint: you may use the schematic diagram shown aside]



$L_1 = 2S_A - S_D$ = constant

$L_2 = 2S_B - S_C$ = constant

⇓

$2V_A - V_D = 0$

$2V_B - V_C = 0$

⇓

$2a_A - a_D = 0$

$2a_B - a_C = 0$

$V_C = -4$ m/s

$a_D = 8$ m/s²

$V_D = 0$

$t = 0$

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[a] $2a_A - a_D = 0 \Rightarrow 2a_A - 8 = 0 \Rightarrow 2a_A = 8 \Rightarrow a_A = \frac{8}{2} = 4$ m/s²

Coincidental answer

$X_A = X_0 + V_0 t + \frac{1}{2}at^2$

$-5 = 0 + 0 + \frac{1}{2}(4)t^2 \Rightarrow 5 = 2t^2 \Rightarrow t^2 = 2.5 \Rightarrow t = 1.58$ sec

(b) $V_A = V_0 + at \Rightarrow V_A = 0 \mp 4(1.58) = \mp 6.32$ m/s

$2V_B - V_C = 0 \Rightarrow 2V_B - (-4) = 0 \Rightarrow 2V_B = -4$

$\Rightarrow V_B = \frac{-4}{2} = -2$ m/s

8/10

A/QA1

$V_{A/B} = V_A - V_B = 6.32 - (-2) = 6.32 + 2 = 8.32$ m/s

$= -4.32$